

Application No.: 10/025,852

Docket No.: 503.41039X00

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A manufacturing method of a fuel injection valve that is equipped, on part of the circumference of an injection hole outlet opening, with a restriction wall which restricts the movement of fuel so that the fuel, injected from the injection hole and given a circling force, attains a component along the circling direction; wherein[[:]]

of the two ends of the restriction wall on the circumference, there is provided a wall that extends, with its height along the direction of the injection hole center axis, from one end located in the upstream of the circling direction of the fuel and parts, while extending from the end, from the edge of the injection hole outlet opening; and

when, at least, either the height of the wall or the angle between a direction along which the wall extends from the end perpendicularly to the injection hole center axis and a line which connects the two ends on the circumference of the restriction wall is changed, at least either one of the two ends is changed of its position on the circumference, and

the fuel injection valve generates a spray profile that contains a concentrated spray portion and a thin spray portion, when viewed along the cross section perpendicular to the injection hole center axis of the injected fuel, and the positional relation between the concentrated spray area and the thin spray area is changed by varying the height or angle of the wall, and position of the one end.

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2. (Currently Amended) A manufacturing method of a fuel injection valve that is equipped, on part of the circumference of an injection hole outlet opening, with a restriction wall which restricts the movement of fuel so that the fuel, injected from the injection hole and given a circling force, attains a component along the circling direction; wherein[[:]]

of the two ends of the restriction wall on the circumference, there is provided a wall that extends from one end located in the upstream of the circling direction of the fuel and parts, while extending, from the edge of the injection hole outlet opening; and

fuel injection valves with different spray profiles are manufactured by varying an angle, formed between a direction along which the wall extends from the end perpendicularly to the injection hole center axis and a line which connects the two ends on the circumference of the restriction wall, from 180 degrees, and

the fuel injection valve generates a spray profile that contains a concentrated spray portion and a thin spray portion, when viewed along the cross section perpendicular to the injection hole center axis of the injected fuel, and the positional relation between the concentrated spray area and the thin spray area is changed by varying the angle.

3. (Original) A manufacturing method of a fuel injection valve according to Claim 1 or 2,

wherein the restriction wall and the wall, which parts from the edge of the injection hole outlet opening while extending from the end of the restriction wall, form a continued wall.

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4. – 5. (Canceled)

6. (Currently Amended) A fuel injection valve that is equipped, on part of the circumference of an injection hole outlet opening, with a restriction wall which restricts the movement of fuel so that the fuel, injected from the injection hole and given a circling force, attains a component along the circling direction; wherein[[:]]

of the two ends of the restriction wall on the circumference, there is provided a wall that extends, with its height along the direction of the injection hole center axis, from one end located in the upstream of the circling direction of the fuel and parts, while extending from the end, from the edge of the injection hole outlet opening; and

an angle, formed between a direction along which the wall extends from the end perpendicularly to the injection hole center axis and a line which connects the two ends on the circumference of the restriction wall, is made smaller than 180 degrees, when measured from the direction of the wall towards the line in the opposite direction of the circling of the fuel, viewing the tip of the fuel injection valve with the injection hole opening from the downstream of the spray injected from the injection hole.

7. (Currently Amended) A fuel injection valve that is equipped, on part of the circumference of an injection hole outlet opening, with a restriction wall which restricts the movement of fuel so that the fuel, injected from the injection hole and given a circling force, attains a component along the circling direction; wherein[[:]]

of the two ends of the restriction wall on the circumference, there is provided a wall that extends, with its height along the direction of the injection hole center axis,

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from one end located in the upstream of the circling direction of the fuel and parts, while extending from the end, from the edge of the injection hole outlet opening;

an angle, formed between a direction along which the wall extends from the end perpendicularly to the injection hole center axis and a line which connects the two ends on the circumference of the restriction wall, is made smaller than 180 degrees, when measured from the direction of the wall towards the line counterclockwise, viewing the tip of the fuel injection valve with the injection hole opening from the downstream of the spray injected from the injection hole; and

an angle, formed between a line which connects the end located in the downstream of the restriction wall in the circling direction of the fuel and the injection hole center and a line which connects the end located in the downstream of the restriction wall in the circling direction of the fuel and the injection hole center, is made greater than 180 degrees, when measured from the line towards the direction counterclockwise, viewing the tip of the fuel injection valve with the injection hole opening from the downstream of the injected fuel.

8. (Currently Amended) A fuel injection valve that is equipped, on part of the circumference of an injection hole outlet opening, with a restriction wall which restricts the movement of fuel so that the fuel, injected from the injection hole and given a circling force, attains a component along the circling direction; wherein

of the two ends of the restriction wall on the circumference, there is provided a wall that extends, with its height along the direction of the injection hole center axis, from one end located in the upstream of the circling direction of the fuel and parts, while extending from the end, from the edge of the injection hole outlet opening; and

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an angle, formed between a direction along which the wall extends from the end perpendicularly to the injection hole center axis and a line which connects the two ends on the circumference of the restriction wall, is made greater than 180 degrees, when measured from the direction of the wall towards the line in the opposite direction of the circling of the fuel, viewing the tip of the fuel injection valve with the injection hole opening from the downstream of the spray injected from the injection hole.

9. (Currently Amended) A fuel injection valve that is equipped, on part of the circumference of an injection hole outlet opening, with a restriction wall which restricts the movement of fuel so that the fuel, injected from the injection hole and given a circling force, attains a component along the circling direction; wherein[[:]]

of the two ends of the restriction wall on the circumference, there is provided a wall that extends, with its height along the direction of the injection hole center axis, from one end located in the upstream of the circling direction of the fuel and parts, while extending from the end, from the edge of the injection hole outlet opening;

an angle, formed between a direction along which the wall extends from the end perpendicularly to the injection hole center axis and a line which connects the two ends on the circumference of the restriction wall, is made greater than 180 degrees, when measured from the direction of the wall towards the line in the opposite direction of the circling of the fuel, viewing the tip of the fuel injection valve with the injection hole opening from the downstream of the spray injected from the injection hole; and

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an angle, formed between a line which connects the end located in the downstream of the restriction wall in the circling direction of the fuel and the injection hole center and a line which connects the end located in the downstream of the restriction wall in the circling direction of the fuel and the injection hole center, is made smaller than 180 degrees, when measured from the line towards the direction in the opposite direction of the circling of the fuel, viewing the tip of the fuel injection valve with the injection hole opening from the downstream of the injected fuel.

10. (Original) An internal combustion engine in which fuel is injected into a cylinder, using a fuel injection valve equipped with an injection hole directed towards the cylinder inside, the injected fuel is ignited, using an ignition system equipped with an ignition device in the cylinder, and the piston installed in the cylinder is reciprocated;

wherein the fuel injection valve equipped there is a fuel injection valve according to any one of Claims 6 to 9; and

of the two ends of the restriction wall, the fuel injection valve is so installed that the movement direction of the fuel comes approximately together with the direction of the ignition device along the tangential direction at one end located in the downstream of the circling direction.

11. (Original) An internal combustion engine in which fuel is injected into a cylinder, using a fuel injection valve equipped with an injection hole directed towards the cylinder inside, the injected fuel is ignited, using an ignition system equipped with

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an ignition device in the cylinder, and the piston installed in the cylinder is reciprocated;

wherein the fuel injection valve equipped there is a fuel injection valve according to any one of Claims 6 to 9;

the fuel injection valve is installed close to the ignition device; and

of the two ends of the restriction wall, the fuel injection valve is so installed that the movement direction of the fuel comes approximately together with the direction of the ignition device along the tangential direction at one end located in the upstream of the circling direction.

12. (Original) An internal combustion engine in which fuel is injected into a cylinder, using a fuel injection valve equipped with an injection hole directed towards the cylinder inside, the injected fuel is ignited, using an ignition system equipped with an ignition device in the cylinder, and the piston installed in the cylinder is reciprocated;

wherein the fuel injection valve equipped there is a fuel injection valve according to any one of Claims 6 to 9;

the fuel injection valve is installed close to the ignition device; and

the fuel injection valve is so installed that a thin spray area of the fuel injected from the fuel injection valve is directed towards the ignition device.

13. (Currently Amended) An internal combustion engine according to Claim 11 or Claim 12,

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wherein the fuel injection valve and the ignition device are installed between a suction valve for sucking air into the cylinder and an exhaust valve for discharging exhaust from the cylinder.

14. (Original) A fuel injection valve according to any one of Claims 6 to 9, wherein equipped with a connecting means for electrical connection with an external device, and the connecting means being located at a position opposite to the direction of a concentrated spray area of the fuel injected from the injection hole, viewing from the center axis of the injection hole.

15. (New) An internal combustion engine according to Claim 12, wherein the fuel injection valve and the ignition device are installed between a suction valve for sucking air into the cylinder and an exhaust valve for discharging exhaust from the cylinder.